

OXYGEN ISOTOPES IN PYROXENES FROM TWO VIGARANO CAIS VARY INDEPENDENTLY OF fO_2 .

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Introduction: A hallmark of Ca-Al-rich inclusions (CAIs) is enrichment in most of their constituent minerals in ^{16}O , taken to be the isotopic signature of the gas in which they formed. Other minerals that are ^{16}O -poor likely underwent later exchange with a different isotopic reservoir after formation [e.g. 1]. However, recent work [2] has shown that some CAIs sampled multiple distinct reservoirs during their primary formation, either as a result of temporal variations in the composition of the gas or because the CAIs were transported to different isotopically-distinct regions, before being accreted into the parent body. Analyses of the isotopic and chemical compositions of pyroxene from two different Vigarano CAIs (F6; a compact Type A, and F8; a fluffy Type A) sheds new light on the environment in which the CAIs underwent isotopic exchange.

Methods: Minerals were analyzed with a JEOL 8900 electron probe at the Smithsonian Institution. Oxygen isotopes were analyzed using the University of Hawai'i Cameca ims 1280, in multicollector mode (see [3]). Al-Mg isotopes were analyzed using the University of Wisconsin Cameca ims 1280 (see [4]).

Results and Discussion: High-precision Al-Mg dating of F6 and F8 [4] gives initial $^{26}Al/^{27}Al$ ratios of $(5.3 \pm 0.3) \times 10^{-5}$ (F8) and $(4.2 \pm 0.4) \times 10^{-5}$ (F6), corresponding to a $\sim 200,000$ year time difference. The Ti-rich pyroxene in F6 plots on the ^{26}Al isochron and is ^{16}O -rich ($\Delta^{17}O = -20.6 \pm 1.6\%$ and $-23.8 \pm 2.0\%$); similar pyroxene in F8 plots on the F8 ^{26}Al isochron but is consistently ^{16}O -poor ($\Delta^{17}O = -2.6$ to $-4.1 \pm 1.5\%$). The pyroxene in F8 rims (replaces) perovskite, which also is ^{16}O -poor, so the pyroxene must post-date perovskite exchange. Pyroxene in both F6 and F8 contains on average $\sim 60\%$ Ti^{3+} . Pyroxene in the Wark-Lovering rim (WL) of both inclusions is ^{16}O -rich ($\Delta^{17}O \sim -22$ to $-23 \pm 2.8\%$). F6 is almost uniformly ^{16}O -rich, even melilite. Melilite in F8, however, is variably depleted in ^{16}O .

During the time of F6 and F8 evolution, O-isotopes in their environs varied greatly yet fO_2 did not. This is hard to reconcile with CAI transport from dust-poor to relatively dust-rich environments [2]. Low fO_2 persisted during the formation of the WL rims [5], yet these two CAIs solidified 200,000 years apart. Either the rims themselves formed at different times, or else all rims formed late at a time that post-dated the formation of F6.

References: [1] Clayton R. N. et al. 1977. *Earth and Planetary Science Letters* 34:209–224. [2] Yurimoto H. et al. 2008. *Reviews in Mineralogy and Geochemistry* 68:141–187. [3] Makide K. et al. 2009. *Geochimica et Cosmochimica Acta* 73:5018–5050. [4] MacPherson G. J. et al. 2010. Abstract #2356. *41st Lunar & Planetary Science Conference*. [5] Simon S. et al. 2007, *Geochimica et Cosmochimica Acta* 71:3098–3118.